Proficiency with multidigit calculations

Multidigit multiplication

Students who are having difficulty with multiplication of multidigit numbers may know some things about multiplication, but not yet be fluent. Multiplication involves several concepts and several strategies. You can work down the following list of strategies and concepts to find out what the student still needs to understand.

10. Does the student make typical errors when using the standard algorithm?

    Some students know most of the steps of the standard algorithm but make typical errors, which can be corrected with direct instruction on the concepts behind the algorithm. See the section on errors below.

```
  54
 x 6
 300
  24
 324
```

```
  54
x 23
  12
 150
  80
1000
1242
```

9. Can the student use the partial product method or lattice method?

    The lattice method, and a variation of the partial product method, are shown at the end.

8. Does the student have any strategies for solving the problem, such as grouping or skip counting, or creating more easily managed sub-problems?

    This might involve an intuitive use of factors, for example:
    54 x 6 = 54 x 2 x 3 = 108 + 108 + 108. The use of this strategy depends on the problem. In this case, doubling 54 was relatively easy, and adding it 3 times was also relatively easy. Give the student simple problems like this to try.
    In the second example above, the student might simplify the problem like this:
    (54 • 10) + (54 • 10) + 108 + 54

7. Does the student understand the distributive property with simple problems?

    e.g. 54 • 6 = (50 • 6) + (4 • 6) = 300 + 24 This is the concept behind both the partial product algorithm (which makes much more sense to students) and the standard algorithm. In both cases, students multiply the ones, ten, hundreds, etc. separately. This problem is easily worked out mentally when a student understands how to use the distributive property.

6. Do graphical representations help, such as area representations?

    Start with simple ones, such as 7 x 8 and 7 x 10, to make sure students understand the concept. They should make a connection to finding the area of rectangles, where the question is: “How many unit squares cover the entire rectangle?” Area representations that show clusterings of 100’s and 10’s are easier to add up (they are related to base 10 blocks) and students can use them to see the distributive property, as shown in the example at the end.

5. If the problem is put in context, can the student estimate an answer? Does the context give the student a clue about how to solve the problem directly?

> Contexts such as price, rates, comparisons, or simply “6 groups of 54” sometimes help the student visualize the problem – for example, “If you travel 54 miles each day for 6 days, how far would you travel altogether?” The student might round down to 50 miles and easily figure 50 x 6 = 300. Let the student make a drawing, if that helps.

4. Can the student estimate using rounding or compensating?

> Rounding example given above. Compensating involves adjusting each factor, for example, 95 x 11 could be estimated using 100 x 10. Good for checking the reasonableness of answers.

3. Does the student understand the concept of multiplication?

> Multiplication is grouping – skip counting (repeated addition) is counting by groups. Area representations show the concept graphically.

2. Does the student know how to multiply by 10’s and 100’s?

1. Does the student know and draw on basic facts and other number relationships?

> Basic number combination facts are learned easily over time by most children, when their teachers use a program that builds on students’ innate problem-solving abilities and allows them to develop multiple strategies for number combinations. The use of flash cards alone does not result in fluency with number facts for most students. They need to build familiarity with fact families through exposure to the facts in many problem situations and through the development of increasingly abstracted strategies for processing more difficult number combinations.

Common errors using multidigit algorithms

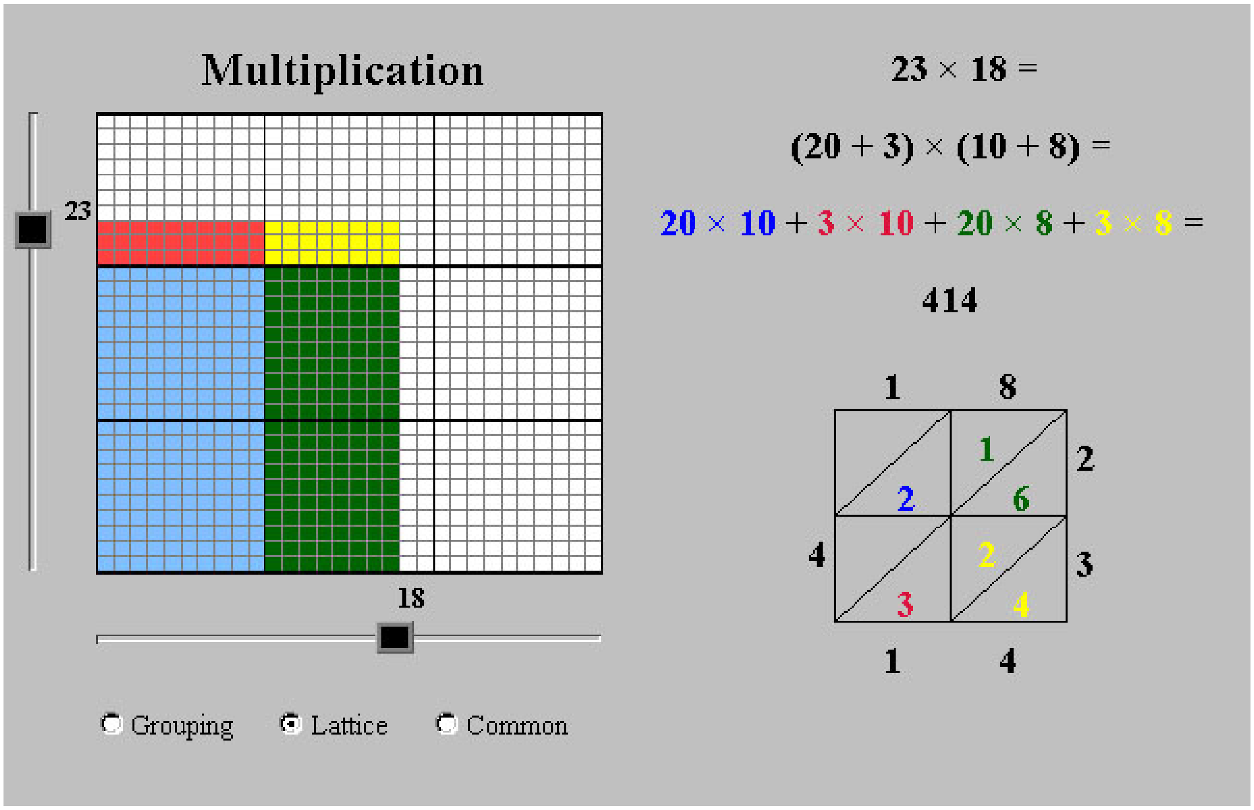
There is no need to teach the standard algorithm if the student makes too many errors with it – students can be fluent with the partial product method. Or use the lattice method if you insist on something more compact. It is less error-prone. (See graphic at end for lattice method. It is the same as the standard algorithm, only on the diagonal.)

Typical errors using the standard algorithm involve not accounting correctly for place value, especially when there is a zero in one of the numbers to be multiplied.

Another error involves not knowing what to do with the number that is “carried.” In this example, the student multiplied 7 x 4 and got 28. He put down the 8 and wrote the 2 above the ten’s place. But then he added the 2 and the 5 *before* multiplying by 4.

$$\begin{array}{r} {\scriptstyle 2} \\ 57 \\ \times\ 4 \\ \hline 288 \end{array}$$

Area multiplication showing the lattice method
http://nlvm.usu.edu/en/nav/frames_asid_192_g_2_t_1.html
Color coding in the original document is used to point out the distributive property.



Variation on partial product method:

18 x 23	10	8	
20	200	160	360
3	30	24	54
			414